

Notice of Allowability

Application No.

10/789,756

Examiner

Tiffany A. Fetzner

Applicant(s)

LUDWIG ET AL.

Art Unit

2859

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 12/12/2006 & the telephonic interview of 02/16/2006.
2. ☒ The allowed claim(s) is/are Examiner Amended claims 1-8, 10-17, and 19-20.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date 02/16/2006.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.
2. Authorization for this examiner's amendment was given in a telephone interview with **Attorney John A. Hamilton Reg. No. 48,946** on February 16th 2006 along with authorization to charge any necessary fees to applicant's deposit account. No fees are believed to be due at this time
3. The application has been amended as follows:

A) Replace claim 1 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 1**:

Claim 1 --- A multi-modal RF coil capable of being used within an MRI system, comprising:

a segmented annular base ring conductor having a central axis and including at least one segment **configured** for direct connection to an arcuate conductor and at least two additional segments;

a plurality of capacitive electrical connections, at least one of the capacitive electrical connections disposed between each of the segments of the segmented annular base ring conductor; and

at least one arcuate conductor symmetrically disposed with respect to the central axis of the **segmented annular** base ring conductor, each arcuate conductor disposed in a corresponding plane orthogonal to the base ring conductor and each **at least one arcuate conductor respectively** having a first end and a second end terminating at spatially distinct positions along the segmented annular base ring conductor, each first end terminating in direct contact with one of the at least one segment(s) of the segmented annular base ring conductor **configured for** direct connection to at least one of the arcuate conductors, and each second end **of each respective at least one**

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arcuate conductor providing an electrical connection between two of the at least two additional segments of the segmented annular base ring conductor via at least two of the plurality of capacitive electrical connections of the segmented annular base ring conductor;

wherein the plurality of capacitive electrical connections of the segmented annular base ring conductor comprise fixed or tunable capacitive electrical connections permitting resonance tuning of the **multi-modal** RF coil. ---

B) Replace claim 2 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 2**:

Claim 2 --- The multi-modal RF coil of **claim 1**, wherein:

the at least one arcuate conductor comprises a single arcuate conductor; and
the **multi-modal** RF coil being operable in two modes in phase quadrature **in order** to establish a rotating magnetic field phasor orthogonal to a temporally constant uniform magnetic field generated by the MRI system. ---

C) Replace claim 3 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 3**:

Claim 3 ---The multi-modal RF coil of **claim 2**, wherein:

the segmented annular base ring conductor is capable of establishing a first of two modes as a result of current flowing circularly through the annular base ring conductor; and

a second of two modes is established by a 90° phase shifted current flowing through the at least one arcuate conductor and split between two halves of the segmented annular base ring conductor,

wherein the multi-modal RF coil is operable in phase quadrature. ---

D) Replace claim 4 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 4**:

Claim 4 ---The multi-modal RF coil of **claim 1**, wherein:
the at least one arcuate conductor comprises a plurality of arcuate conductors;
and
the **multi-modal** RF coil is operable in a plurality of modes **in order** to establish a rotating magnetic field phasor orthogonal to a temporally constant uniform magnetic field generated by the MRI system. ---

E) Replace claim 5 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 5**:

Claim 5 ---The multi-modal RF coil of **claim 1**, wherein the at least one arcuate conductor defines a selected cut in an anatomical region **that is** imaged by the MRI system. ---

F) Replace claim 6 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 6**:

Claim 6 ---The multi-modal RF coil of **claim 1**, wherein the segmented annular base ring conductor is comprised of a plurality of microstrip line segments. ---

G) Replace claim 7 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 7**:

Claim 7 ---The multi-modal RF coil of **claim 1**, wherein the at least one of the arcuate conductors is comprised of a plurality of microstrip line segments. ---

H) Replace claim 8 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 8**:

Claim 8 ---The multi-modal RF coil of **claim 1**, wherein **each** at least one arcuate conductor further comprises:
a plurality of conducting segments; and
at least one tunable capacitive electrical connection disposed in a gap between each of the conducting segments **in order to establish** resonance with the inherent coil inductance at a target frequency. ---

I) Cancel claim 9 of the **December 13th 2005** Amendment and response.

J) Replace claim 10 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 10**:

Claim 10 ---The multi-modal RF coil of **claim 1**, wherein at least one reactance associated with the plurality of capacitive electrical connections compensates some or all of the inherent coil inductive reactance at a resonant frequency. ---

K) Replace claim 11 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 11**:

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Claim 11 ---The multi-modal RF coil of **claim 1**, wherein at least one of the plurality of capacitive electrical connections matches **an** impedance of a corresponding transmission line connecting the **multi-modal** RF coil to receiving electronics. ---

L) Replace claim 12 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 12**:

Claim 12 --- The multi-modal RF coil of **claim 1**, wherein the **multi-modal** RF coil is dimensioned so as to receive a human breast. ---

M) Replace claim 13 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 13**:

Claim 13 ---The multi-modal RF coil of **claim 1**, further comprising:
two electrical ports **configured** for accessing electrical signals induced in the **multi-modal** RF coil; and
means for modifying the accessed electrical signals **in order** to interface with a single or a multi-channel receiver amplifier. ---

N) Replace claim 14 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 14**:

Claim 14 --- A pair of multi-modal RF coils of the type set forth in **claim 1**, and
wherein the pair of **multi-modal** RF coils are disposed in a manner so as to enable imaging of two anatomical regions by the MRI system. ---

O) Insert claim 15 of the December 13th 2005 Amendment and response:

Claim 15 ---The pair of multi-modal RF coils of **claim 14**, wherein the two anatomical regions comprise a pair of human breasts. ---

P) Insert claim 16 of the December 13th 2005 Amendment and response:

Claim 16 ---The pair of multi-modal RF coils of **claim 14**, further comprising:
two pairs of electrical ports, each pair of electrical ports capable of accessing electrical signals induced in one of the multi-modal RF coils. ---

Q) Replace claim 17 of the December 13th 2005 Amendment and response with the following Examiner amended claim 17:

Claim 17 ---The pair of multi-modal RF coils of claim 16, further comprising means for modifying the accessed electrical signals **in order** to interface with a single-channel receiver amplifier. ---

R) Cancel claim 18 of the December 13th 2005 Amendment and response.

S) Replace claim 19 of the December 13th 2005 Amendment and response with the following Examiner amended claim 19:

Claim 19 --- The multi-modal RF coil of **claim 14**, further comprising one or more PIN diodes arranged in shunt with the plurality of capacitive electrical connections, the diodes being switchable between high and low impedance states that are capable of

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operating at a resonant frequency so as to actively tune, or de-tune, the **multi-modal** RF coil. ---

T) Replace claim 20 of the December 13th 2005 Amendment and response with the following **Examiner amended claim 20**:

Claim 20 --- An MRI system, including:

- a main magnet component providing a temporally constant and uniform magnetic field;

- at least one gradient coil producing a pulsed, linear field gradient;

- at least one RF coil acting as a transmitter;

- at least one multi-modal RF coil comprising

- a segmented annular base ring conductor having a central axis and including at least one segment **configured** for direct connection to an arcuate conductor and at least two additional segments;

- a plurality of capacitive electrical connections, at least one of the capacitive electrical connections disposed between each of the segments of the segmented annular base ring conductor; and

- at least one arcuate conductor symmetrically disposed with respect to the central axis of the **segmented annular** base ring conductor, each arcuate conductor disposed in a corresponding plane orthogonal to the base ring conductor and each **at least one arcuate conductor respectively** having a first end and a second end terminating at spatially distinct positions along the segmented annular base ring conductor, each first end terminating in direct contact with one of the at least one segment(s) of the segmented annular base ring conductor **configured for** direct connection to at least one of the arcuate conductors, and each second end **of each respective at least one arcuate conductor** providing an electrical connection between two of the at least two additional segments of the segmented annular base ring conductor via at least two of the plurality of capacitive electrical connections of the segmented annular base ring conductor;

wherein the plurality of capacitive electrical connections of the **segmented annular** base ring conductor comprise fixed or tunable capacitive electrical connections permitting resonance tuning of the **multi-modal** RF coil; and electronics **configured** for transmitting and receiving electrical signals from the at least one multi-modal RF coil. ---

The following is an examiner's statement of **Reasons for Allowance**:

4. With respect to **Examiner amended independent claims 1, and 20** These claims are considered to be allowable over the prior art of record by the examiner because the prior art of record does not disclose or suggest "A multi-modal RF coil capable of being used within an MRI system, an MRI apparatus/method comprising each of the structural limitations, as set forth with the specified connections of **examiner amended independent claims 1 and 20**. Specifically it is the locations and connections of the specified **segmented annular base ring conductor**, the locations and connections of the **plurality of capacitive electrical connections** and the locations and connections of the **at least one arcuate conductor**, **in combination with the remaining limitations of each of the claims, which is applicant's novel inventive structure**. It is the entire combination of the claim limitations taken as a whole that constitutes both the novelty and non-obviousness of applicant's claims.

5. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Examiner's Comment

Drawings

6. The drawing objections from the September 9th 2005 office action are **rescinded** in view of applicant's amendments to the specification and the applicant's corrections to

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figures 3 and 5, which were filed with the amendment and response of December 13th 2005.

7. The Official Draftsperson has approved the corrected Replacement drawing sheet containing **figures 3 and 5** as well as the drawings of **figures 1, 2, 4a-4c, and 6-9** which were submitted on **July 26th 2004**.

Prior Art made of Record

8. The **prior art made of record** and not relied upon is considered pertinent to applicant's disclosure.

A) Nabetani et al., US patent 6,348,794 B1 issued February 19th 2002, filed January 18th 2000.

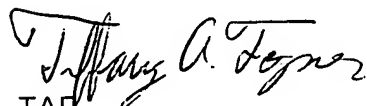
B) Lian et al., US patent 5,804,969 issued September 8th 1998.


C) See all of the Prior arts of record noted on the attached PTO 892 Notice of References Cited form, as well as each of the prior art references noted by the examiner and by applicant, throughout the prosecution of this application.

Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

10. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(703) 872-9306**.


TAF
February 17, 2006 ✓


fr
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